# Comparative Study of Head-Mounted Displays

## Project Number: 94-16

## Investigator: S. Richardson/EO66

### Purpose

The purpose of this study is to compare the CRT-based low-vision enhancement system (LVES) with LCD-based head-mounted displays (HMD's).

### Background

One of the goals of the Army-NASA Virtual Innovations Laboratory (ANVIL) is to provide human factors analysis earlier in the hardware and operations development process and develop more effective training and mission support systems. It is also important to develop, assess, and validate the hardware used in the lab to produce accurate analysis.

One of the peripherals used in immersive VR systems is the head-mounted display (HMD). A HMD consists of two small displays positioned in front of the user's eyes and a spatial tracking device that is coupled with the user's head movements. When the user's head moves, the computer updates the image on the displays in respect to this movement. There are several important characteristics of HMD's—resolution, horizontal field of view, and color. In addition, the displays can be LCD based or cathode ray tubes.

The effect these characteristics have on human performance in the virtual world is not completely understood. By properly varying the color, resolution, and horizontal field of view, data can be collected to provide insight to these factors.

### Approach

The LVES has been procured and modified to operate with the computer systems in the lab. Virtual Environment Performance Assessment Battery (VEPAB) software will be loaded and modified to run on the Silicon Graphics (SGI) workstation with the six-degree-of-freedom Shuttle hand controllers. Objects in the virtual world will be converted to also output grayscale images. In addition, verification that all HMD's are working with the system will be done. Finally, approval from the IRB will be requested and data will be collected to empirically compare the HMD's used in the lab.

### Accomplishments

VEPAB object libraries were originally obtained from the U.S. Army Research Institute (ARI). The libraries would not compile on the SGI workstation in the lab because of the different type of computer license that resides on it. The source code was then obtained, and numerous modifications were made to enable the software to run on the workstation. Several enhancements were also needed based on conclusions from the original study completed at ARI, and to generate a grayscale image for the other HMD's to be used in the study besides LVES.

The second milestone that was accomplished was an additional piece of hardware was integrated into the system. The six-degree-of-freedom hand controllers were incorporated to provide movement for the subjects.

The experimental design for the study has been completed. This step is needed to ensure that the data collected from the subjects' performances will result in a comparison of the correct independent variables.

## Planned Future Work

The following is a list of tasks that needs to be completed:

- Integrate new HMD, Fakespace into the system;
- Complete and submit IRB package for approval of the use of human subjects;
- Request and screen volunteers for participation in the study;
- Schedule orientation sessions for the subjects;
- Collect and analyze data; and
- Submit final report.

## Funding Summary ($k)

| | FY94 | FY95 | FY96 |
|---|---|---|---|
| Authorized: | 6.5 | - | - |
| Obligated: | - | 4.8 | - |

| | FY97 | Total |
|---|---|---|
| Authorized: | - | 6.5 |
| Obligated: | - | 4.8 |

## Status of Investigation

The new HMD will be integrated by the end of the first quarter of FY98. The IRB package is in the process of being completed. Pending approval from the board, request for volunteers should begin by the end of January. By the end of February, volunteers should begin orientation and data collection should begin.